NATURAL GAS IN MONTANA

A Report to the Governor
from the
NATURAL GAS MARKETING ADVISORY COUNCIL
June, 1992

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REFERENCES

Throughout this report certain units of measurement are used.

SCF: One standard cubic foot

MCF: One thousand standard cubic feet

BCF: One billion standard cubic feet or 1,000,000 MCF

TCF: One trillion standard cubic feet or 1,000,000,000 MCF

A typical residential home uses approximately 110 MCF on a annual basis.

Total U.S. natural gas consumption in 1990 was 18.8 TCF.

Associated Gas: Gas produced along with crude oil.

BTU (British Thermal Unit): Represents the heating value of gas. BTU will vary in gas production/processing. Pipeline quality gas (merchantable) generally runs from 950 to 1200 BTU per standard cubic foot (SCF).

Formation: A succession of sedimentary beds that were deposited continuously and under the same general conditions. It may consist of one type of rock or of alterations of types. An individual bed or group of beds distinct in character from the rest of the formation and persisting over a large area is called a "member" of the formation. Formations are usually named for the town or area in which they were first recognized and described, often an a place where the formation outcrops.[1]

Stratigraphic Trap: A reservoir, capable of holding oil or gas, formed from a change in the character of reservoir rock from a break in its continuity. For example, the loss of porosity and permeability in a tight sandstone updip forms a stratigraphic trap.[2]

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[1] From Manual of Oil and Gas Terms, Seventh Edition, Williams and Meyers, 1987.

[2] *ibid*

ILLUSTRATIONS

INTRODUCTION

Montana has been a natural gas producing state since 1915, and during this 77 year period, over 2.2 trillion cubic feet (TCF) of natural gas has been produced from Montana's gas fields. Presently, the states' annual gas production ranks Montana 20th in the nation on the list of natural gas producing states.

Montana's first natural gas discovery occurred in 1912 on the Cedar Creek anticline near the town of Baker in extreme eastern Montana. Commercial production began in 1915. Today gas is produced in a number of fields around the state with the largest producing fields located in north central and northwest Montana, (Figure 1).

Annual production peaked at 59 billion cubic feet (BCF) in 1973 and has been relatively steady since 1979 with volumes ranging from 47 to 59 BCF per year. As stated earlier, cumulative production exceeds 2.2 TCF.

Montana Governor Stan Stephens signed an executive order on October 31, 1990, creating the Natural Gas Marketing Advisory Council. The purpose of this council essentially is three fold:

(1) Evaluate Montana's natural gas potential through geological and other means and provide estimates of productive reserves;

(2) Evaluate obstacles to development of any reserves;

(3) Evaluate present and potential markets for Montana gas and formulate a marketing strategy to improve the state's ability to produce and sell its natural gas.

In addition, the council is charged with informing potential markets as to Montana's natural gas capabilities and with recommending to the Governor administrative and legislative policies that would increase the potential to develop and market Montana's natural gas reserves.

EXECUTIVE SUMMARY

Montana has significant proven and probable reserves of natural gas. Development is hampered due to a lack of markets, lack of access and detrimental economic and governmental factors. Development would be economically and environmentally beneficial to the state. This report will discuss reserves, marketing, access, economics and governmental impact.

Natural gas was first discovered in Montana in 1912 and commercial production began in 1915. To date, over 2.2 trillion cubic feet (TCF) have been produced from Montana gas fields.

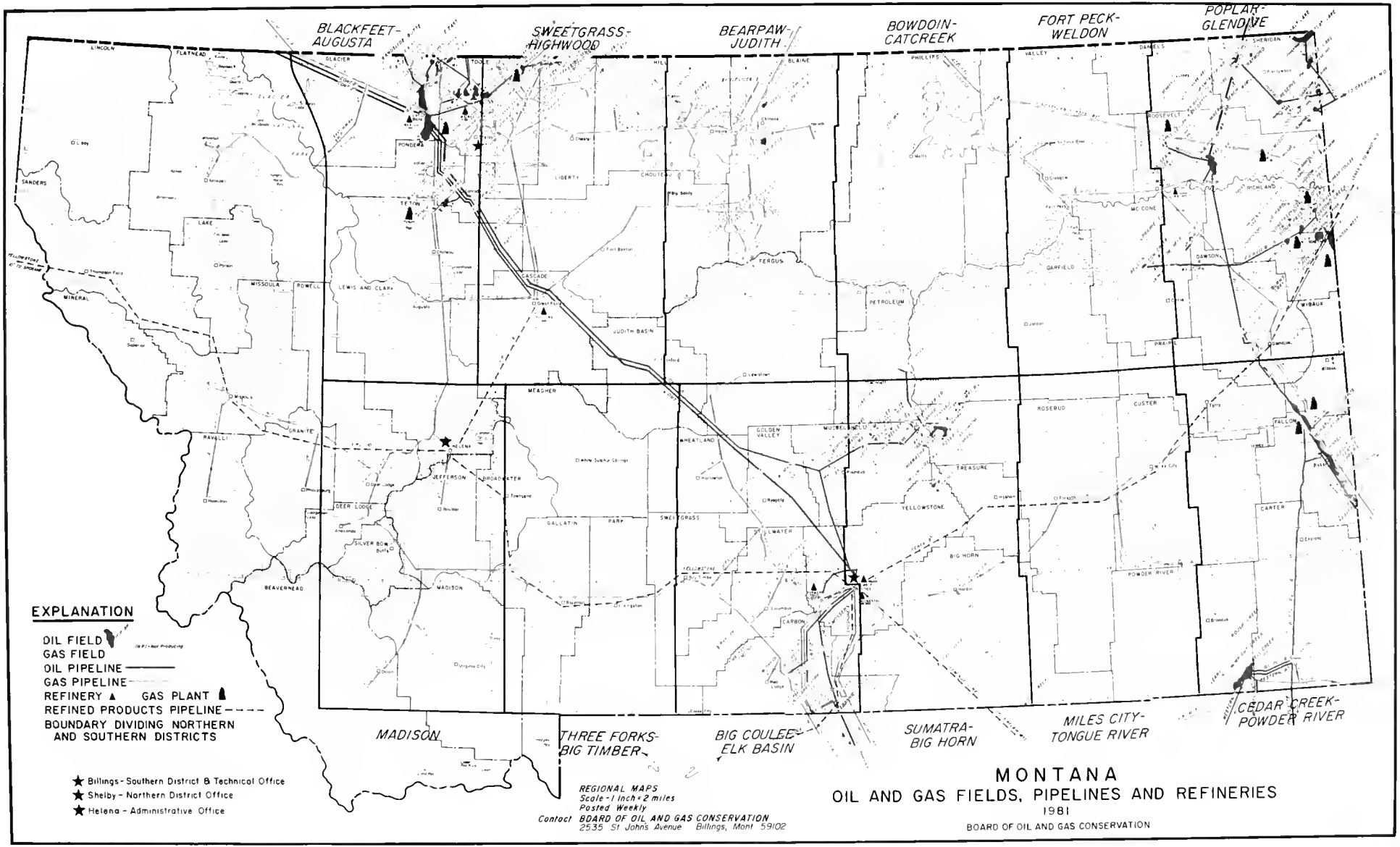
Montana has proven reserves of 830 billion cubic feet (BCF) of natural gas, which is a 17.3 year supply for Montana at present consumption levels. Geologic and engineering data indicate that an additional 3.285 TCF is probable from "conventional" sources and 5.995 TCF is possible for a total of 9.280 TCF in the probable and possible categories. "Non-conventional" gas (such as coal-bed methane and tight sand gas) adds over 20 TCF to the possible speculative category for a grand total of 29.728 TCF in all categories.

Montana has 16 separate geologic provinces which have future natural gas potential, half of which are already producing. The area with the greatest potential for giant reserves from conventional reservoirs is the western overthrust belt, but coal-bed reserves in the huge coal areas of eastern Montana could have equally great potential.

Development of the state's natural gas potential is restricted due to lack of in-state markets, limited access to federal lands in areas of high potential, high production taxes (highest in nation), and intense price competition from Canada and other producing states.

To develop the large reserve potential, either large users, (most likely industrial) must establish operations in the state or large gas users in other states must be accessed. Due to "open access," gas can now be moved to out-of-state markets, but transportation costs are high because of distance from markets. Montana's "best bet" is to turn to market potential in its own backyard. A few prospects to build natural gas use are: attract new industry; provide a cleaner fuel for existing industries and forms of transportation currently using other fuels; or as a primary or secondary fuel in co-generation projects.

Specifically, Montana's best natural gas market potential lies in power generation, transportation fuel for both locomotives and automobiles, agri-business (fertilizer plants, grain drying, etc.), cement and hot mix plants, enhanced oil recovery projects, wood product plants, talc processing plants and smelters.


BLACKFEET-AUGUSTA
SWEETGRASS-HIGHWOOD
BEARPAW-JUDITH
BOWDOIN-CATCREEK
FORT PECK-WELDON
POPLAR-GLENDIVE
MADISON
THREE FORKS-BIG TIMBER
BIG COULEE-ELK BASIN
SUMATRA-BIG HORN
MILES CITY-TONGUE RIVER
CEDAR CREEK-POWDER RIVER
EXPLANATION
OIL FIELD
GAS FIELD
OIL PIPELINE
GAS PIPELINE
REFINERY
GAS PLANT
REFINED PRODUCTS PIPELINE
BOUNDARY DIVIDING NORTHERN AND SOUTHERN DISTRICTS
Billings - Southern District & Technical Office
Shelby - Northern District Office
Helena - Administrative Office
REGIONAL MAPS
Scale - 1 Inch = 2 miles
Posted Weekly
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MONTANA
OIL AND GAS FIELDS, PIPELINES AND REFINERIES
1981
BOARD OF OIL AND GAS CONSERVATION

RECOMMENDATIONS

The oil and gas industry contributes a significant portion of Montana's tax revenue each year and provides a number of high paying jobs to citizens of this state. The industry has suffered in recent years due to collapse of both oil and gas prices and the Canadian natural gas imports, and when industry revenues suffer, so do state and local government revenues. It is time, therefore, for government and industry to form a "partnership" in order to develop and market Montana's vast natural gas supplies.

Several steps could be taken which could encourage exploration, development and marketing of Montana gas.

Governmental Recommendations

(These recommendations and obstacles to development are discussed in more detail on pp 32-33 and 47-52).

1. Promote Montana's business image. State officials make calls and visits to emphasize the positive aspects of natural gas exploration and development. Allay fears of unreasonable treatment by government agencies.

2. Simplify taxation and bring more into line with neighboring states. Reduce the four different petroleum taxes to one or two. Total gas taxes should be no higher than oil taxes. Enact permanent two-year holiday on new production.

3. Use Resource Indemnity Trust (RIT) taxes to plug and abandon orphan wells.

4. Eliminate or reduce dual taxation on tribal lands. List those lands that are off-limits to oil and gas development.

5. Limit revenue audits by the state to one year within a five-year period. Enact a five-year statute of limitations.

6. Control workers' compensation costs. The current rates and liabilities are a major detriment to attracting investors. Consider privatization.

7. Work with industry and the federal government to allow access to public lands that are neither wilderness nor national parks.

RECOMMENDATIONS

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7. Work with industry and the federal government to allow access to public lands that are neither wilderness nor national parks.

8. Alleviate unreasonable environmental challenges to oil and gas development when those operations pose no threats to the environment.

9. Encourage investment in and income from state lands through a state royalty holiday and encouraging use of state-owned surface for pipelines and gas-consuming facilities.

10. Educate the state's economic development committees and other organizations to the value and availability of Montana natural gas.

Recommendations to Industry

Market share and growth will be the key to establishing respectable gas prices and development promotion. Producers must bring market understanding to the forefront of their operations. This entails:

1. Knowing the existing markets/end users both in state and out.

2. Knowing what potential markets may exist and working toward their development. Potential markets include power generation, agri-business, transportation and are discussed in detail at the end of the Marketing section.

   In Montana examples of new market potential are: Power generation, including electric generation, co- generation, co-firing applications with other fuels; Transportation, including railroad, through use of refrigerated liquid methane (RLM) to fuel locomotives and use of compressed natural gas (CNG) in vehicles.

   Agri-business is a significant market for malting barley, fertilizer plants and grain drying. Other uses are: cement and hot mix plants, enhanced oil recovery projects, wood product plants, talc processing plants and smelters.

3. Knowing the competition for the markets and the competitive factors.

4. Understanding and taking a role in pipeline services, i.e., rates, quality of service, storage potential, operating characteristics. Work with pipelines to ensure that regulatory

barriers do not exist which would impair timely capacity expansion opportunities.

5. Exploring the potential of producer gas sales co-ops or utilization of aggregators in sale of gas.

6. Understanding pipeline gathering facilities and being prepared to engage in that activity.

7. Awareness of who the industry is: producers, aggregators, pipelines, markets, regulators.

   Publishing a directory of gas producers, pipelines, aggregators and markets doing business in Montana.

8. Working with state, federal and tribal governments to educate officials and to achieve regulation parity with other competing gas supplies (continental) and alternate competitive fuels (coal, propane, fuel oil, etc.).

9. Promoting natural gas as the "fuel of choice" to federal/state officials and general public.

   Promoting Montana natural gas at industry trade shows and market events.

10. Establishing a natural gas resource marketing contact.

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MARKETING OF MONTANA GAS

OVERVIEW OF GAS TRANSPORTATION, STORAGE AND UTILIZATION

TRANSPORTATION

Generally, three functions are associated with delivery of gas from the wellhead to the end-user. Gathering lines collect gas from individual wells and move the product either to a transmission mainline or to a processing facility, depending on the gas quality. Gas not of pipeline or merchant quality must be processed. Compression also is necessary. If the gas is processed, the residue product is delivered from the processing facility to the transmission line. Usually, gas that requires processing is produced in association with oil.

Once gas is gathered from a production source to the transmission or main trunkline, it is redelivered either directly to end users or, more typically, to distribution systems usually located within towns. The owner/operator of a distribution system is referred to as a Local Distribution Company (LDC).

Ownership and operation of gathering, transmission and distribution systems can occur in any combination. For instance, a company such as Montana Power owns gathering, transmission and distribution systems. Or, a producer could own a gathering system, the pipeline company could be a different entity and the local distribution system again be owned/operated by a different company such as Great Falls Gas Company or Montana-Dakota Utilities Company. It is also possible for the LDC to be a city owner (municipal system). The pipeline company/system may also operate/own storage facilities which may be necessary to meet peak day demand requirements as well as to insure system delivery reliability and integrity. While storage operations are complex, the service may be simply characterized as the banking of produced gas for use at a later date.

Transmissions systems throughout the North American continent are now interconnected to the point where gas can be moved from one geographic region to another.

Either federal (Federal Energy Regulatory Commission - FERC) or state regulators are empowered to regulate the pipeline or LDCs services (i.e. rates, transportation, sales, storage, etc.).

Pipelines which move gas in interstate commerce (such as Williston Basin Interstate Pipeline Company and Colorado Interstate Gas Company) are regulated by the FERC while intrastate pipelines (Montana Power Company) and LDCs are regulated by state Public Service Commissions (PSC).

Due to changes in attitude of both the regulator and industry, at the federal and state level, the pipeline is no longer mainly a buyer and reseller of gas (merchant) but is now a transporter, somewhat similar in nature to an "open access" common carrier. This process has been termed "unbundling". The interstate pipelines with facilities in Montana are all open access transporters and have followed the national trend in that substantially more volumes move through their systems relative to transportation service than sales gas by pipelines (approximately 83% transportation and 17% sales in 1991).

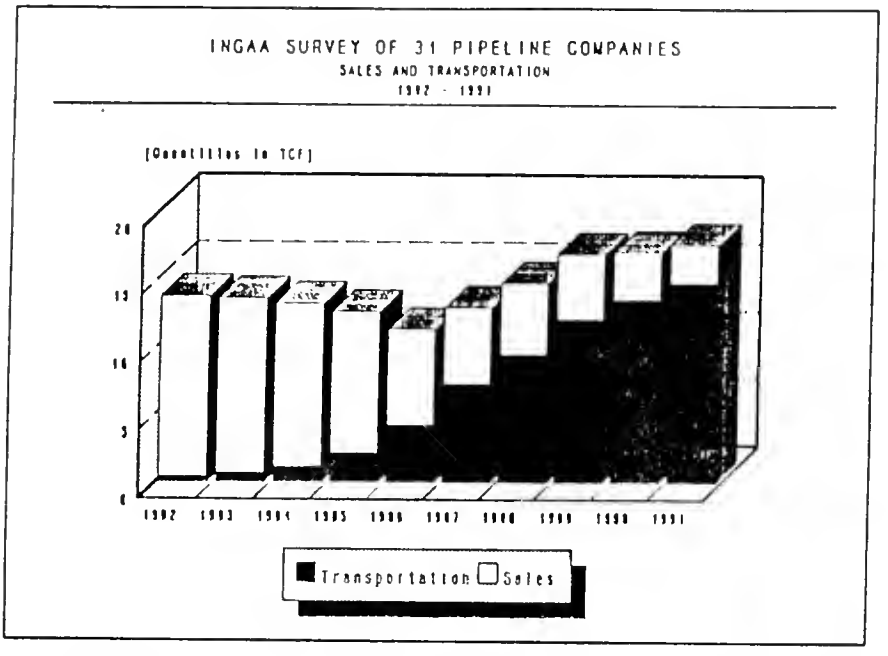


*Figure 2 data source - INGAA Rate and Policy Analysis Department - Issue Analysis - Carriage Through the First Half of 1991.

*Note: Responses from 31 pipelines represent 86 percent of gas deliveries as measured by interstate natural gas sales and deliveries of gas transported or compressed for others in 1989 according to the Department of Energy, Energy Information Administration, Statistics of Interstate Natural Gas Pipeline Companies, 1989.

Figure 2

All data pursuant to INGAA survey except 3rd and 4th quarter, 1991 which was estimated by Council.

Interstate natural gas pipelines doing business in Montana are Colorado Interstate Gas Company, Northern Border Pipeline Company, Northern Natural Gas Company and Williston Basin Interstate Pipeline Company. Montana Power Company is an intrastate pipeline.

All of the interstate pipelines doing business in Montana are "open access." Montana Power has begun "open access" on a limited basis with transportation being available for certain identified non-core customers. Further transformation from sales to transportation for Montana Power Company may occur over the next several years.

Transportation services are generally of two types -- **Firm and Interruptible.** In transportation services, either firm or interruptible, the pipeline only transports the gas and is not involved in the purchase or sale of the gas. Consequently, the pipeline is not responsible for the security or availability of the supply. Under the **Firm** service, the party (shipper) contracting for the service with the pipeline pays for the reservation of space to move identified volumes from specific receipt points to specific delivery points. The shipper pays for the reserved space whether or not gas is actually moved. The pipeline obligates itself to move the gas volumes but only to the extent that the gas is made available to the pipeline to transport. The pipeline has no obligation to ensure that the gas supply is available and delivered to it. Shippers with firm transportation capacity generally provide service to end-users or LDCs that do not have the ability to go without gas (such as to switch to an alternate fuel on a moment's notice) like residential and commercial customers. In Montana, firm customers usually have weather-sensitive loads; therefore during periods of moderate temperatures, firm space under contract may not be used. Thus, since a certain amount of capacity is necessary to meet peak day firm customer requirements, and this capacity must be paid for even if not used, the utilization factor or "load factor" dictates how expensive the firm transportation service is. As an example, if a firm customer requires a maximum 100 MCF per day load to handle the coldest day of the year, it needs to contract for that 100 MCF transportation capacity all year to ensure it is available on the coldest day. Since the shipper does not use the 100 MCF throughout most of the year, but pays for the reserved space, the firm service is more costly than interruptible.

Throughout the year, pipelines must monitor their systems to ensure the firm that shippers requirements are being satisfied up to the maximum reserved capacity. Service to firm customers is why pipelines were originally built. However, due to market changes over the years and the fact that during certain periods of non-peak demand all of the available space is not used, the pipeline makes such space available on an interruptible basis. This service is not as costly as firm since the user is subject to being interrupted at any given time. The interruptible customer and service does play a valuable role in keeping overall rates down to all shippers and pipeline services by providing a contribution to all pipeline costs. This is taken into consideration in regulatory rate making proceedings.

With the pipelines changing role from merchant to transporter, the buyers and sellers of gas may also include producers, marketers or aggregators, LDCs or specific end-users. Any one of these may also assume the shipper role on the pipeline and hold the transportation agreement. The shipper is also responsible for scheduling deliveries to and receipts from the pipeline (nominations). This added administrative burden must be taken into consideration when choosing transportation.

Within the new wave of buyers/sellers, the aggregators have been most predominant. They provide not only market availability but also arrange for supply portfolios to fit those markets. Producers with limited gas availability tend to use aggregators due to aggregators' ability to utilize the supply as part of a portfolio. Examples: a limited supply is too costly to market on its own or insufficient volumes and reliability to satisfy the end-users needs.

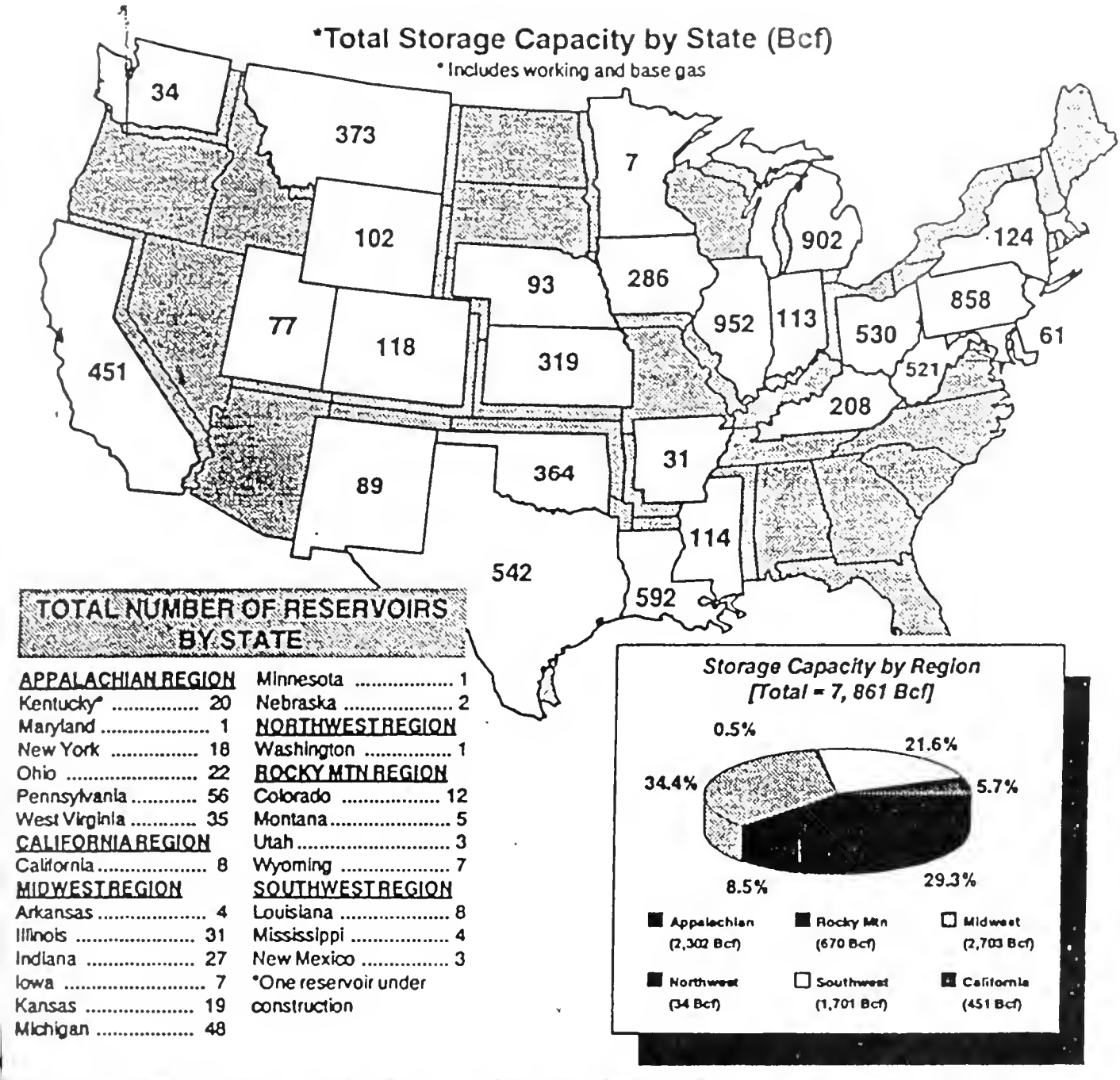
Pipeline system capabilities (capacities) vary between companies and geographic location of each system. Over time, as mentioned earlier, the North American pipeline system has been interconnected so that Montana producers can access markets throughout the continent. Likewise, Montana markets can access supplies available throughout the continent.

STORAGE

A key element to providing reliable pipeline deliveries is the relationship of storage capabilities. Storage capacity and deliverability vary with respect to storage fields. Storage fields may be previously depleted reservoirs, salt dome caverns or similar geological formations capable of holding gas. Storage is operated through injection and withdrawal wells.

Figure 3, Page 15, Total Storage Capacity by State (BCF), shows how storage availability varies throughout the lower 48 contiguous United States.

As depicted in Figure 3, Montana has significant storage capabilities which are of great value in marketing production. Storage can be utilized by producers to produce gas during a period of low price and sell later at a higher price. Conversely, markets may use storage to purchase at a low price period for delivery during a later higher demand cycle. The expertise gained over the past several years by producers, aggregators and purchasers has led to high use of storage and moderation of seasonal price variances.



These charts represent the total amount of storage capacity available including working and base gas broken down by state.

Figure 3 - Data Source: Gas Storage Report, July 1991.

COMPRESSION

As a result of varying pipeline sizes, capacities and operational characteristics, compressors are used to provide energy needed to transport natural gas along a pipeline/storage system. Compressors may also be used to boost pressure from one pipeline system to another. If the pressure differential between systems is large, then significant horsepower may be needed and the expense may result in uneconomic operating or installation situations, especially with respect to moving small volumes into large high pressure lines. The proposed Altamont and existing Northern Border pipelines are examples of such high pressure lines.

UTILIZATION

MONTANA'S OWN NEEDS

Since the first discovery of natural gas in 1912, Montana's demand for natural gas grew steadily to nearly 80 BCF in the 1970s. By 1990, total gas use within Montana had fallen to approximately 43 BCF. (Reasons for the decline include the closure of the ARCO [Anaconda] mining, smelting and refining operations; conversion to other fuels [coal], and conservation [average home use has dropped from 200 MCF/year in the early '70s to 110 MCF/year by 1990]). Figure 4 demonstrates Montana's sectoral gas use based on a five year average of 1986 through 1990 data.

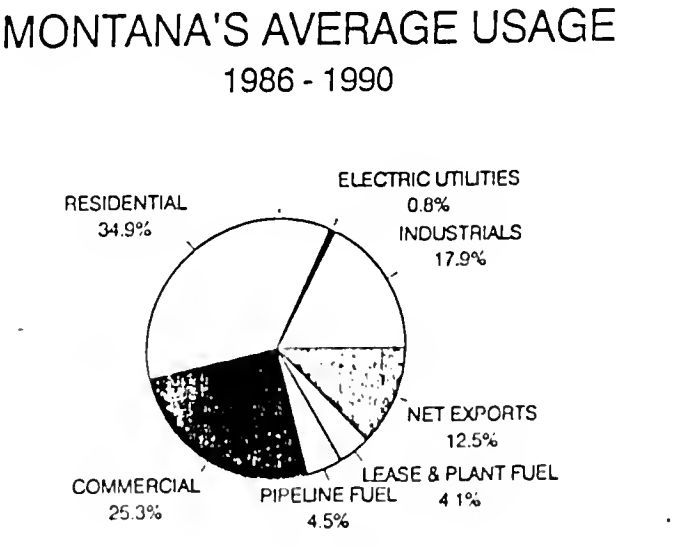


Figure 4 -
Data per Energy Information Administration (EIA)/Natural Gas Annual 1990.

Given Montana's present gas reserve profile (See Section on potential reserves, starting on P. 37) along with the existing and proposed pipeline grid within the state, it is reasonable to conclude that Montana's existing and future gas markets will have access to sufficient gas supplies from throughout Montana, as well as other regions of the U.S. and Canada.

While in-state markets have served as the cornerstone of its gas industry development, Montana has historically been a net exporter. However, with deliverability declining, the percentage of net exports is also on a decline. Nevertheless, given the significant reserve potential, a strong Montana gas industry will depend upon its ability to compete in an export market. Since 75-80% of the state's natural gas production is from gas wells (as opposed to gas produced in association with oil), potential market demand and price for natural gas control and determine the growth rate which the gas industry can expect in the future.

MARKET EXPORT OPPORTUNITIES

Figure 5 shows states with net marketed production in the U.S. for 1990.

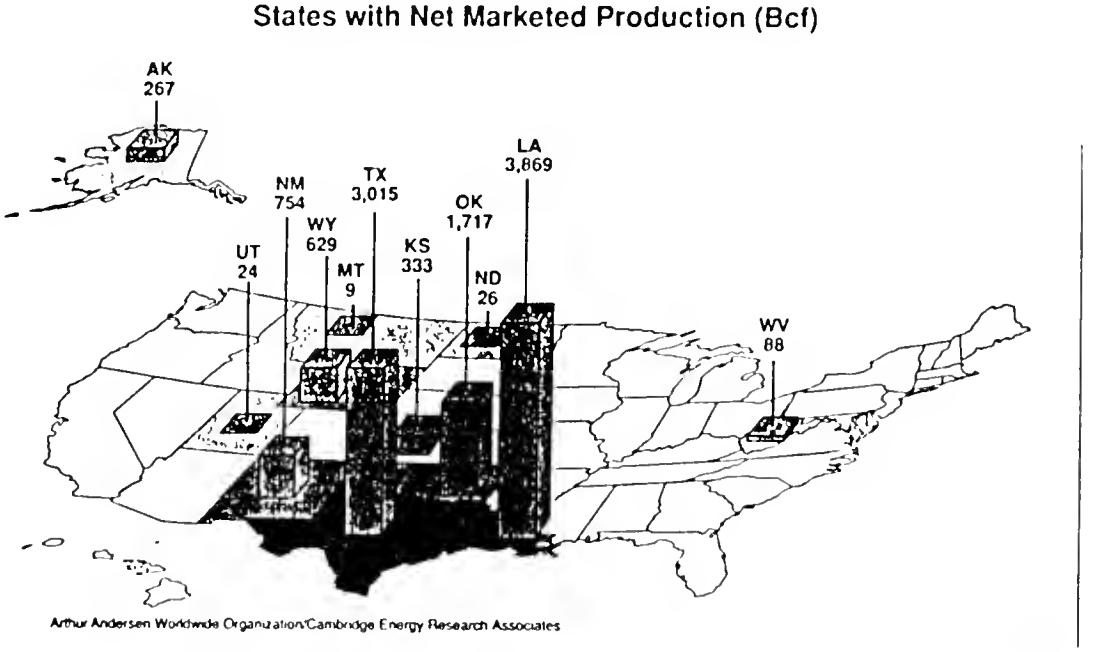


Figure 5

Data Source: Natural Gas Trends, 1991 Edition - Cambridge Energy Research Association.

Typically, the geographical proximity between the wellhead and market will correlate to a greater or lesser netback price a producer can expect for his product (commodity). Natural gas is similar to other commodities in that it is significantly affected by transportation or delivery costs. Given Montana's slow economic growth along with limited industry, large gas users in other states must be accessed to provide for development of Montana's large gas reserve potential.

Since Montana is geographically at a disadvantage when compared to other gas producing states (i.e. distance to large gas use markets), competition with other exporting states and Canada will be extremely intense. Figure 6 demonstrates the relationship between primary markets and primary producing regions within the U.S.

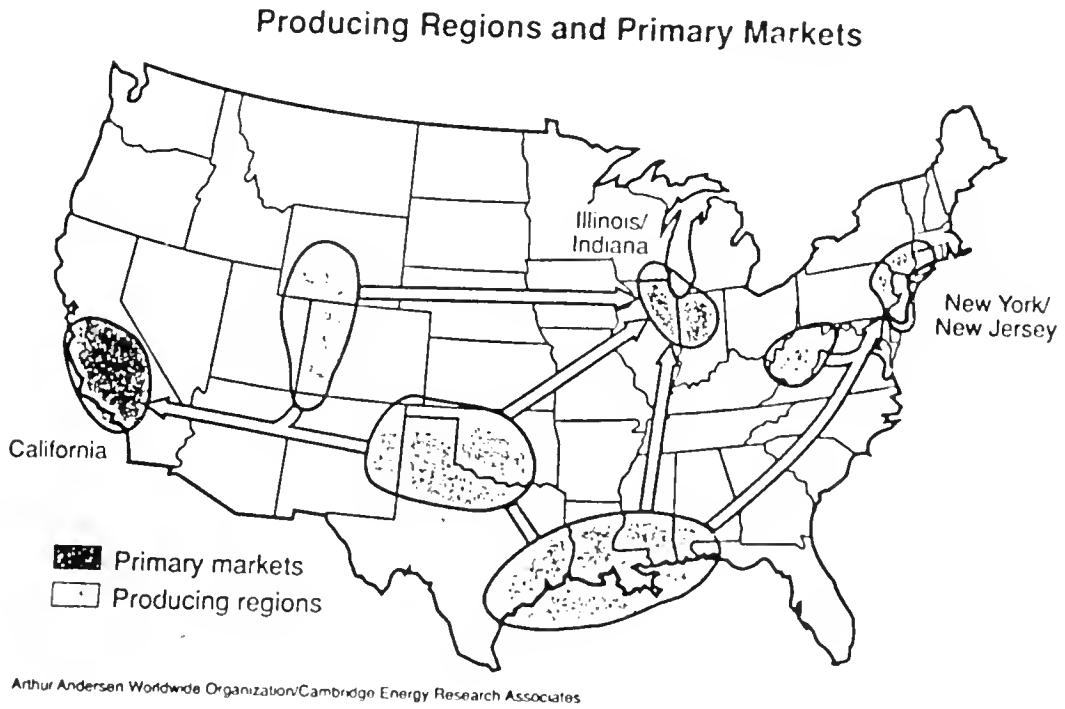


Figure 6

Natural Gas Trends, 1991 Edition - Cambridge Energy Research Association.

BRINGING SUPPLY AND MARKETS TOGETHER

Until the mid '80s, natural gas producers concentrated their efforts on finding and producing natural gas. They let the pipelines and LDCs transport and market the gas to the burnertip. Today, gas producers have to assume a more involved role in gas marketing. With expanded market options also come increased uncertainty and risk as more buy and sell transactions take place between the wellhead and the burnertip. Producers now have the option to sell their gas directly to the following parties:

a). a pipeline company
b). an LDC
c). an end-use customer
d). a marketer or gas aggregator, or
e). a combination of any of the above

Most gas was marketed for resale to pipelines prior to the mid 1980s. In many cases, a producer was able to flow a somewhat level daily volume of gas to the pipeline, and subsequently the pipeline assumed the responsibility of meeting the customers' (i.e. LDC or end-user) daily average and peak day gas needs. The pipeline accomplished this through the utilization of its storage facilities, line pack management (squeezing more gas into line when higher demand is foreseen, e.g. when a cold snap is predicted) and interruptible load scheduling.

Throughout the 1980s "open access" pipeline transportation began to evolve on a nation-wide basis. This has allowed gas suppliers seeking markets and marketers for gas supplies to come together by "accessing" two or more pipeline systems. The result has been an increase in gas-to-gas competition throughout the natural gas industry. Through the acceptance by a pipeline to become an open-access transporter, the pipelines' former customers began to convert their firm gas needs from the pipeline to some other gas supplier. Consequently, the pipelines' merchant role has been declining steadily since the mid '80s as depicted in Figure 7 on the following page.

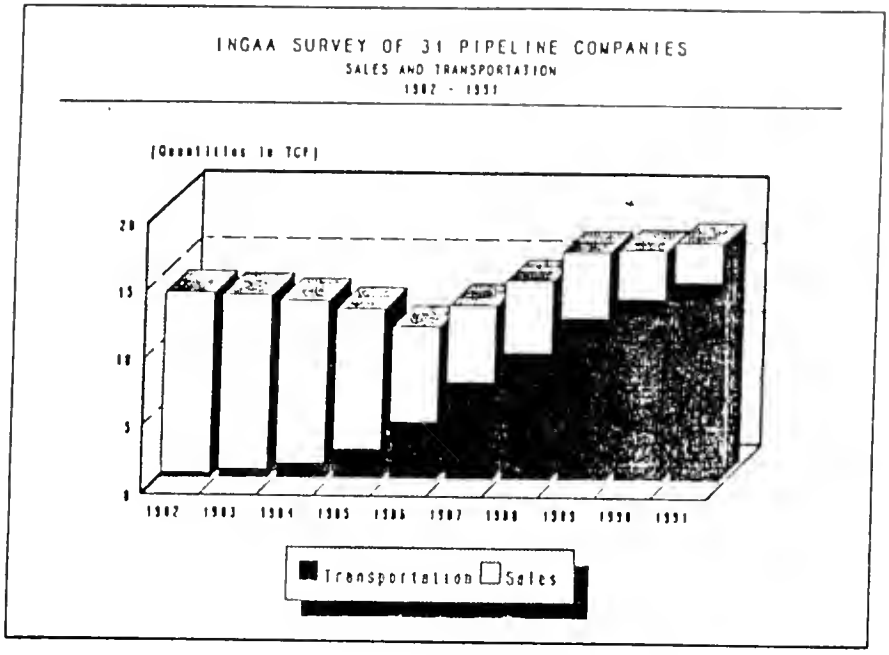


*Figure 7 data source - INGAA Rate and Policy Analysis Department -- Issue Analysis -- Carriage Through the First Half of 1991.

*Note: Responses from 31 pipelines represent 86% of gas deliveries as measured by interstate natural gas sales and deliveries of gas transported or compressed for others in 1989, according to the Department of Energy, Energy Information Administration, Statistics of Interstate Natural Gas Pipeline Companies, 1989.

As a result of an increasing number of market choices, gas producers -- especially smaller independents -- may have a difficult time finding a market which meets their economic agenda. Certain gas producers in Montana may not find it feasible to effectively market their product on an independent basis.

PRICE AND TRANSPORTATION TRENDS

PRICE

Under the Natural Gas Act of 1938, interstate gas was price regulated. The Natural Gas Policy Act (NGPA) of 1978 provided for a phased deregulation of gas prices. Under the NGPA, new gas (initial production post-1977) generally became price deregulated in 1985. The NGPA concept was that old gas (pre '77) would

gradually be depleted, along with price regulation. The NGPA also addressed intrastate prices by establishing ceilings and providing for phased deregulation.

Due to significant disparities between regulated and deregulated gas prices in the mid to late 1980s, federal orders and regulations were instituted to provide limited ability for price regulated gas to become price deregulated. The Wellhead Decontrol Act passed by Congress in 1989 provided the final move towards price decontrol by deregulating then existing regulated gas over a phased period. On January 1, 1993, all gas will be price deregulated.

Intrastate gas was price regulated under the NGPA with deregulation occurring on January 1, 1985.

Many factors have contributed to a decline in gas prices through the '80s and into the '90s. Major factors are:

1). supply exceeding demand with a key contributing factor being several warmer-than-normal winters (national and local)

2). existence and evolution of open access transportation/storage, and

3). price deregulation

For nearly a decade, demand side economics has ruled over supply. There is nothing on the horizon that would indicate when, if ever, this is going to change. As a result, intense competition exists, not only with other fuel sources (propane, fuel oil, coal, etc.) but primarily among gas supplies and suppliers. Competition of gas with itself is referred to as "gas-to-gas" competition. This gas-to-gas competition has resulted in the emergence of the spot market, whereby gas purchasers elect to play the market on a rather continual basis and only commit to purchases on a short term -- 30-, 60-, or 90-day period. The maturing spot market has become a bellwether for overall gas prices (spot prices for various areas of the country/continent are posted as frequently as daily by various industry publications). While long-term (over 90 days) arrangements usually provide for price premium, the differential between spot and long-term prices has been dissipating over the past several years. As long as the oversupply exists, the spot market will continue, although long-term purchases may be gaining attention. The spot market increasingly is the leading price indicator together with gas futures indices. Thus, it is expected that market type (long term vs. spot) differentials will continue to be reduced, especially upon the deregulation of remaining gas price controls (Jan. 1, 1993) and through expiration of previous long-term gas purchase/sale agreements. Gas prices under spot

deals continued to decline since 1987. February 1992 prices were the lowest of any time since pre-NGPA (Dec. 1978) periods.

Industry analysts say prices will not improve dramatically for the balance of 1992, except for a moderate seasonal fluctuation next winter. Cautious price expectations for the rest of the decade are also for only a moderate increase, tracking inflation rates.

PIPELINE CAPACITY TRENDS

Under current Montana supply deliverability, pipeline capacity, both gathering and transmission, is adequate. Constraints, to the extent they exist, will be overcome if the market need exists on a long term basis. Capacity restrictions generally only exist during peak requirements -- also the time when producer prices may be the highest. This creates a boom-or-bust phenomenon and usually low load factors on Montana's pipelines due to the high degree of weather sensitive loads in the region. It is unrealistic to assume that construction of either new pipelines or additions to existing ones will occur if load factor levels are not improved upon. In short, it is uncommon and not competitive under current and expected future market situations to install peaking-only facilities. Unless a market is willing to bear most if not all of the cost of new facilities, the new facilities will not be installed. In some cases a single market may not be enough to warrant new facilities. Rather, a multiple market may be necessary.

Much of Montana's large natural gas resource base lies in areas of little current production and pipeline facilities. Should this resource base be developed, substantial gathering and transmission facilities may be necessary. Therefore, significant volumes and deliverability must exist to warrant new pipelines. Access is also probably more critical to the pipeline industry than to producers, due to the need for traversing more land than is associated with development.

With pipelines placing less emphasis on the merchant function, their focus is on transmission services. As a result, pipelines are not readily expanding gathering systems. This leaves either independent gathering companies, aggregators, or the producers themselves to install gathering systems. A growing trend is for the party marketing the gas to install needed gathering facilities. This creates a more reliable source of supply through production control of the source(s).

If significant new supplies are developed, especially in new geographic areas, necessary pipeline facilities will still only be constructed if the market exists to pay for it. Added facility risks (costs) will not be shouldered to any great extent by pipelines.

Producers face a dilemma. Before, producers concentrated on developing production before marketing it. Now, producers must have a market before they can assume development risks. But, without a product, marketing is difficult so the end result to producers is to assume development risks and/or to find a way to market their gas up front or coincidental to development.

MARKET OPPORTUNITIES

Market growth and development within Montana, as well as nationally, will be the key to achieving optimal utilization of Montana's natural gas resources. As stated in other sections of this report, Montana's geographic location will make it difficult to attract distant markets. Montana's "best bet" is to turn to market potential in its own backyard. Effective utilization of natural gas to attract new industry; or: provide a cleaner, more economical fuel to existing users; achieve environmental compliance; provide an alternative transportation fuel, or as a primary or secondary fuel in co-generation are a few prospects for building Montana's natural gas market base.

Figure 8 demonstrates the competitive position of natural gas as compared to residential electricity and residential fuel oil.

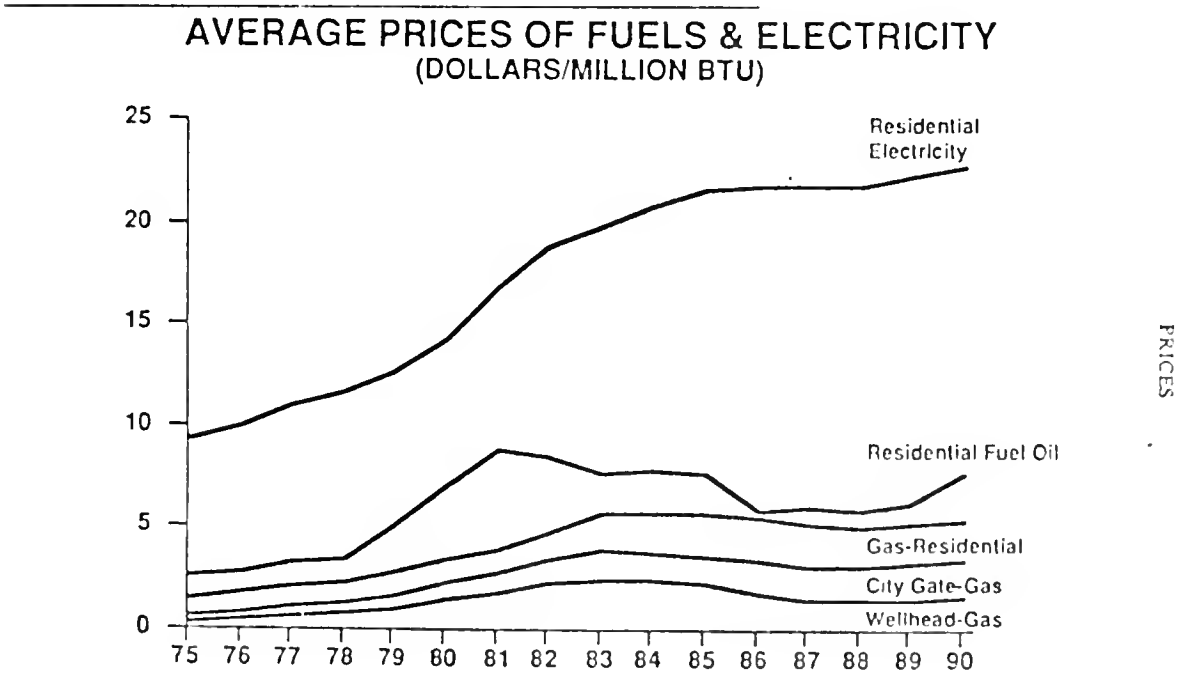


Figure 8

Source -- AGA 1991 Gas Facts -- 1990 Data, Chart 9-1

Natural gas wellhead prices in the U.S. are presently at pre-1980 levels. Gas is experiencing a decoupling relative to oil-related fuels (i.e. under-priced on an equivalent mmbtu basis). As previously stated, a contributing factor to the decline in natural gas prices is prolonged oversupply across the U.S. and Canada, resulting in significant downward price pressures from gas-to-gas competition. For the U.S., federal tax incentives for coalbed methane, tight gas sands and other non-traditional gas sources continue to add new reserves and production to the supply base.

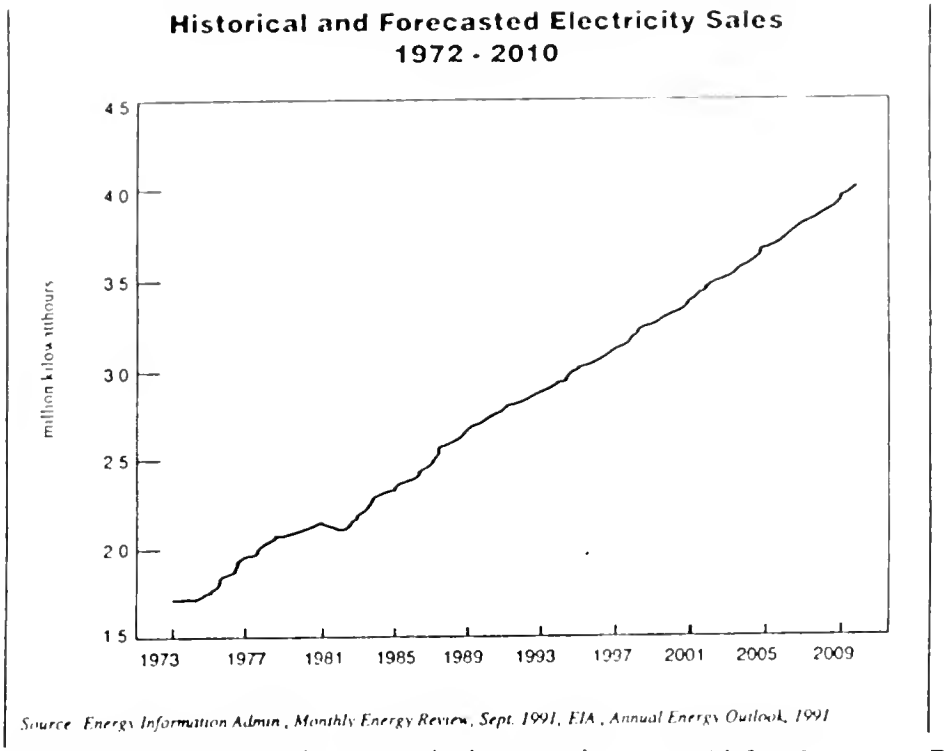
Today's gas market profile within the U.S. will experience significant changes throughout the '90s. A potential return to more normal winters, an end to the economic recession, increased uses in transportation made possible by new technologies and the increasing role of natural gas to achieve compliance with the Clean Air Act Amendments of 1990, will make natural gas the fuel of choice for decades to come. Montana's gas market may also offer similar opportunities to the gas industry. The pages to follow will discuss several identified gas market opportunities within Montana.

ELECTRIC GENERATION

Despite all the attention being gained by natural gas by its environmentally compatible use in natural gas vehicles (NGVs) and residential and commercial uses, the single most significant end-use additional and new market potential for gas is electric power generation.

Over the years, electric utility companies have seen their fuel mix change. Twenty years ago, coal supplied 46% of the fuel needs for electric power generation. Oil accounted for 17%, natural gas 18% and nuclear power only 4%. Today the predominant fuel is coal -- gaining some 56% of the electric generation market. Oil and natural gas have lost substantial market share and now supply only 9% and 4%, respectively, of the electric generation needs. Nuclear's share has soared to 21%. Both coal and nuclear have recently been constrained and concerns are growing about their environmental and human safety issues.

For the refined petroleum products (oil), further growth will be limited by the perception and reality of price volatility (e.g. that recently experienced during the Middle East conflict). Natural gas is in a position to gain a considerable market share in the area of electric generation. Also, electricity use will continue to grow. The Edison Electric Institute statistics show that electric generation was up 2.4% from 1990 to 1991. Figure 9 shows U.S. historical and forecasted electric sales for the period 1972 to 2010 as prepared by the Energy Information Administration.



Source - Energy Information Administration Monthly Energy Review - September 1991
EIA Annual Energy Outlook, 1991

Figure 9

With the Clean Air Act Amendments of 1990, Montana's electric utilities may be a market source of substantially more natural gas by 2000. This may be a least-cost alternative to extensive capital expenditures in power plant modifications.

Natural gas may also experience additional demand from the replacement of aging and environmentally outdated plants. Roughly 100 generating plants around the country representing almost 90,000 megawatts of capacity are targeted for replacement as a result of the Clean Air Act Amendments of 1990[3]. Gas will be an attractive replacement fuel in these plants.

In Montana, natural gas fired electric power generating plants are being proposed to meet growing electricity demand. For example, the Flathead and Lincoln rural electric cooperatives have announced plans to build a gas fired electric generation facility near Eureka. Also, the Montana Power Company has requested proposals for an additional 162 MW of generating capacity. It is believed that this may be satisfied by gas-fired generation facilities.

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[3]Source reference: NYMEX Energy in the News -- Winter 1991/1992. Article by Carol Freedenthal, Jofree Corporation pages 34-37.

Natural gas is attractive in either large base-load stations or in peaking and intermediate load applications where it offers advantages of relatively low capital investment, low operating and maintenance costs and environmental acceptability. Combined cycle or co-generation facilities are playing an ever increasing role in electric generation with natural gas being virtually the fuel of choice. Figure 10 demonstrates this fact.

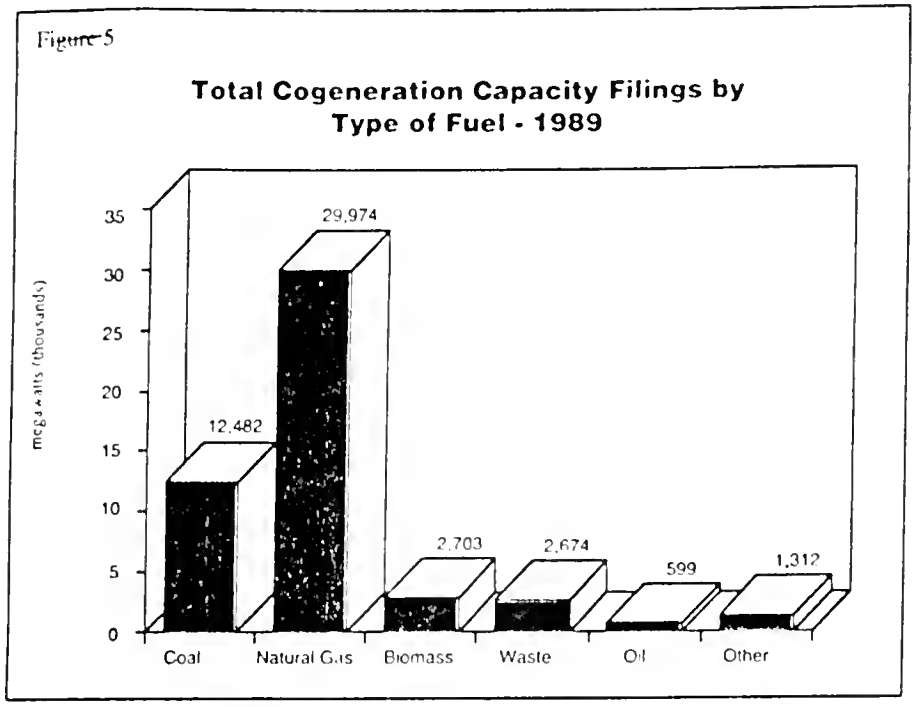

Figure 10

Source Data: NYMEX Energy in the News, Winter 1991/1992

Co-generation is the simultaneous use of a primary fossil fuel for generation of thermal and electrical energy. It becomes most attractive where thermal loads are relatively large and constant.[4] It is believed that many Montana industries have these energy requirement characteristics.

Co-generation in Montana is gaining significance and natural gas will play an increasing role. The United States Department of Energy (DOE) has been actively participating in the funding of new processes and technologies which demonstrate environmental benefits or increased utilization of fossil fuel resources (i.e. clean coal technologies or co-generation facilities). An example in Montana would be the Rosebud Syncoal project near Colstrip, which is being served by natural gas.

While electric generation offers Montana gas producers exciting market opportunities, the difference in philosophies among the two industries threatens the role Montana producers may play in the near-term electric generation market. Utilities who are planning additions to generation capacity are doing so not only to satisfy present-day demand, but also to anticipate growth in electricity demand over long periods of time. The economic viability of this venture requires long-term contracts with relatively fixed prices. The contracts usually contain provisions for inflation and price reopeners but nonetheless satisfy the utilities' need for long-term stable prices. Producers, on the other hand, are generally reluctant in today's low gas price environment to enter into long-term arrangements. The desire of producers to maximize the return on their investment and the utilities' need for long term-relatively stable prices will need to compromise. For other electric generating facilities or co-generation needs, short-term or spot gas deals may suffice or might even be more attractive to a particular electric generation user. The key is for Montana's gas producers to remain open and flexible.

NATURAL GAS IN TRANSPORTATION VEHICLES

On November 15, 1990, Public Law 101-549, "Clean Air Act Amendments of 1990" was signed by President Bush. Amendments include significant reductions in allowable tail pipe emissions. While natural gas vehicles (NGVs) had been around long before 1990, the Clean Air Act, along with increasing environmental concerns, has accelerated the awareness and use of NGVs. In 1989 United

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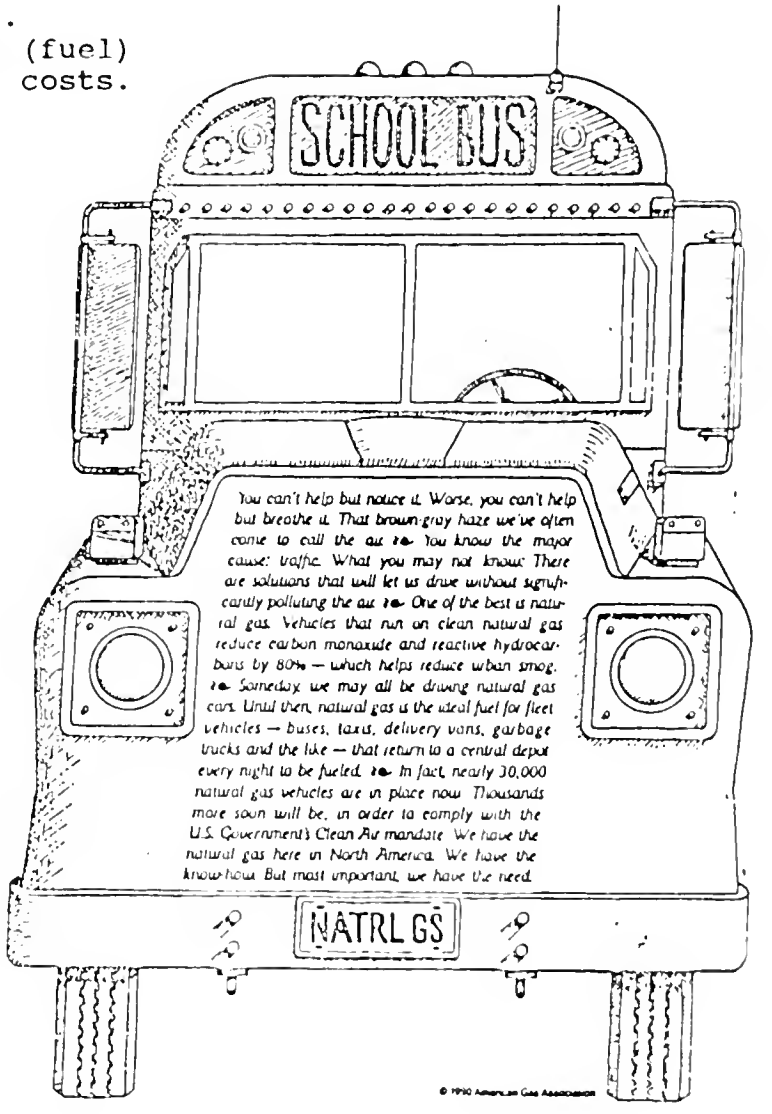
[4]Draft -- 1991 Northwest Conservation and Electric Power Plan, Volume II, Group 5, page 8-48,49.

Parcel Service tested a natural gas pilot project in New York City. Initial emission tests showed an 85% reduction in CO, 25% in NOx, a 23% reduction in CO_2 and a 13% reduction in hydrocarbons over commonly used fuels.[5] Similar results have been produced in other studies. Only hydrogen burns cleaner than natural gas.[6]

Three significant advantages to NGVs are:

1. Lower emissions.
2. Lower operation (fuel) and maintenance costs.
3. Safer fuel.



[5]Dallas Times Herald, July 14, 1990.

[6]A. Gram, Technical Breakthrough: What is Needed to Make LNG a Major Player in Vehicle Fuel Markets; First Continental Conference on Natural Gas Vehicles; Norman, OK; June, 1991.

Progress in developing new technology is advancing daily and may soon overcome most of the disadvantages associated with NGV's. Public acceptance is growing daily and will soon broaden as new technologies help lower conversion costs and fuel tank capacity. Recent announcements by the U.S. big three automakers to produce dual-fueled trucks/pickups and other NGV fleet vehicles will help boost NGV utilization and awareness. Through governmental assistance, progress will continue and new announcements will be made like that of July 1991 when Cummins Engine Company began offering a commercially available 10 liter engine that meets the emission requirements for urban bus emissions and heavy duty trucks. Figure 11 demonstrates the economics experienced by the Garland, TX school district in its first ever school bus conversion program.

. . . . . **COST, SAVINGS & PAYBACK FOR FLEET VEHICLE***

CNG conversion and refueling station	$160,000
Annual fuel costs @ 240 days/year	
Gasoline	$135,000
CNG	73,500
Annual fuel savings.	$ 61,500
Annual operating costs for CNG system. . . .	9,000
Net annual savings	52,500
Years to payback	3

*Based on a 50 vehicle fleet averaging 100 miles per day and 8 miles per gallon using gasoline. Fuel costs were $0.49 per gallon equivalent for CNG and $0.90 for unleaded gasoline. In addition to fuel savings, also maintenance savings and reduction of pollutants. Annual costs included electricity and maintenance for gas compressors.

Figure 11

For CNG, conversion costs vary with vehicle size but normally run between $1,500.00 and $2,000.00.[7] Currently the equivalent fuel cost for CNG varies between $0.40 and $0.70 per equivalent fuel gallon.[8] The compliance with the Environmental Protection Agency (EPA) regulations for liquid fuels stored in underground tanks could add $0.10 to $0.15 more to every gallon of gasoline. CNG does not require underground refueling site storage tanks. Through market testing, it has been reported that vehicular

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[7]Questions and Answers about Natural Gas Vehicles, The Natural Gas Vehicle Coalition.

[8]Natural Gas Vehicle Coalition, Summary of Natural Gas Vehicle Benefits, The Natural Gas Vehicle Coalition.

maintenance costs decreased by 50% or more.[9]

Since NGVs presently have a limited range, more refueling stations will be needed to allow greater travel distances. Based on the February, 1991, American Gas Association (AGA) "Directory of Natural Gas Vehicle Refueling Stations - Products and Services", the United States has over 150 utility operated CNG refueling stations. This number is expected to grow significantly within the next five years. A computer program that can be used to optimize refueling station design is available through IGT.[10] A Lotus template that analyzes all relevant variables of natural gas conversion is available through the Gas Research Institute.[11] Natural Gas Resources Incorporated will perform an economic analysis of conversion to natural gas as a vehicle fuel, free of charge.[12]

Perceptions that natural gas vehicles are unsafe are unfounded. A 1987 survey of utility-operated NGV fleets found that in 434 million vehicles miles, collision rates were roughly equal to gasoline vehicles but the injury rates were 84% of those in gasoline powered vehicles.[13] CNG fuel cylinders are 1/2" to 3/4" thick aluminum or steel and will withstand much more abuse and heat than conventional fuel tanks. Natural gas ignites at about twice the temperature of gasoline and will ignite in a limited gas to oxygen burn range of 5 to 15%. CNG is lighter than air, with significantly reduced explosion potential, unlike propane, diesel or gasoline, which disperse liquids.[14] In Department of Transportation tests, a natural gas fueled vehicle was burned for

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[9]Oil changes at 6,000 miles with natural gas versus 3,000 miles with gasoline. 47% fewer spark plugs in 1984-1985 than 1983-84 with the pattern continuing. 29 exhaust system repairs in 1984-1985 vs 84 repairs in 1983-1984. Carburetor maintenance has been reduced by 85% after conversion to CNG. Status Report, Compressed Natural Gas, 1990, Garland School District, Garland, TX.

[10]Cascade, Institute of Gas Technology 312-890-6466.

[11]Systems Model for Natural Gas Vehicles, GRI-87/0019, 312-399-8100.

[12]CNG Conversion Analysis, 512-251-8891.

[13]Questions and Answers About Natural Gas Vehicles. The Natural Gas Vehicle Coalition.

[14]Maggio M.E., The Impact of Alternative Fuels on Hazards in the Work Place, Transportation Research Board, National Research Council, Eighth Equipment Management Session, May 28, 1990.

more than 30 minutes before relief valves activated, releasing natural gas. The released gas did ignite but did not explode.[15] It is expected that private and public fleet operators will present the most viable opportunity for conversion to natural gas vehicle fuel. Montana may be too rural to present a realistic widespread NGV market.

MONTANA UTILITY CONTACTS FOR NATURAL GAS VEHICLES

Kevin Ringsdahl	Pat Penberthy	Steve Knudson
Montana Dakota Utilities	Montana Power Co.	Great Falls Gas Co.
200 North Fourth Street	40 East Broadway	1 First Avenue South
Bismarck, ND 58501	Butte, MT 59701	Great Falls, MT
701-222-7974	406-723-5421	406-791-7500
701-222-7647 FAX	406-723-4026 FAX	406-791-7560 FAX

NGVs are presently using compressed natural gas (CNG). New technology is being researched and tested to make liquified natural gas (LNG) an economical alternative in other applications. Currently, Burlington Northern and Air Products and Chemicals is testing LNG (referred to as Refrigerated Liquid Methane-RLM) as a locomotive fuel. RLM provides a much longer travel range per comparable storage tank volume but requires more costly refueling liquefaction facilities and on-site as well as vehicular storage tanks than that of CNG. If successful, Burlington Northern could use between 20,000 and 30,000 MCF per day[16] in Montana alone. Montana faces strong competition for this market. Economic incentives may be needed for facilities of this kind to locate in Montana.

INDUSTRIAL USES

For many of the same benefits associated with natural gas use in electric power generation and natural gas vehicles, other industrial users can justify the utilization of natural gas. Although other fuels may seem less costly, natural gas has the lowest net energy cost when environmental costs associated with coke, coal, oil, wood, etc. are included. Other potential industrial users are listed in the market strategies section of this report.

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[15]NGV's: Now on the Fast Track, Reprint from Gas Research Institute Digest, vol 13, no. 1, Spring 1990.

[16]Telephone conversation with Les Olson with Burlington Northern, July 28, 1991.

CONCLUSION: STRATEGIES/RECOMMENDATIONS

As can be seen from previous sections of this report, natural gas marketing is complex and will undoubtedly become more so through time. This council believes that Montana gas can be a viable part of the state and continental U.S. production and utilization. Realities, however, dictate that it will not be an easy task to overcome in achieving that viability.

The current depressed condition of the gas production industry in Montana may not improve appreciably over the next few years. Through cooperative efforts with other industries and governments, the gas production industry can position itself to grow and withstand future industry ups and downs. Therefore, the battle cry may well be -- **MAINTAIN AND POSITION MONTANA'S GAS INDUSTRY TO GROW.**

This Council fully understands the danger in forecasting and therefore bases its recommendations/strategies on building a stronger gas production industry under current realistic conditions and promoting the establishment of a basis for reaction to future changed circumstances, whether they are positive or negative.

RECOMMENDED GOVERNMENTAL ACTION

1. Provide incentives to use state lands.

   a. 24-month royalty holiday on new production.
   b. Make State land available for new markets.
   c. Pipeline right-of-way incentive and/or holiday.

2. Encourage federal and tribal governments to provide incentives to explore their lands. Create a Native American Land Use and Trust Company to unify taxation and development regulations and to designate which lands are acceptable for development.

3. Coordinate Administrative/Regulatory efforts with Tribal Councils.

4. Simplify existing four production taxes by combining into one at a flat rate.

5. Rework Workers' Compensation through privatization.

6. Direct economic development personnel as follows:

   a. Develop expertise (through use of an established industry consulting group) in natural gas matters and promote the value-added concept toward so that Montana's energy needs are met by Montana gas before it is marketed outside the state.

   b. Use an industry-developed directory of gas producers, pipelines, aggregators and markets doing business in Montana. Make directory available.

   c. Attend national gas industry market events to promote Montana's natural gas.

   d. Inaugurate and maintain an education campaign to raise potential markets, governments and generate public's awareness.

MONTANA RESERVES

PROVEN RESERVES

Montana presently has proven reserves of 830 BCF of natural gas. At present consumption levels, this amount represents a 17.3 year supply for the state. This, however, in no way reflects the true potential, which has not been realized due to market and other problems discussed in this report.

METHODS OF EVALUATION OF POTENTIAL RESERVES

Three data sources were used to compile the reserve numbers listed below: (1) a publication entitled "Potential Supply of Natural Gas in the United States" and put together by the Potential Gas Agency, Colorado School of Mines, Harry C. Kent, Director; (2) Balcron Oil Company files; (3) Gas Research Institute data. The method used for estimating the reserves are described by the Potential Gas Agency Publication.

> "The basic technique for estimation of potential gas resources is to compare the factors that control known occurrences of natural gas with factors present in prospect areas. This technique is applied to each of the categories adopted by the Potential Gas Committee. In each case, what is known about the prospective area is evaluated relative to what is known about natural gas accumulations which have been discovered in other parts of the same geologic province or in similar geologic provinces. Natural gas occurrences are related to conditions favoring their formation and accumulation , such as the existence of source rocks, sufficient maturation of organic material, and the presence of reservoir rocks and traps. Studies of producing areas provide information on the productive capacity of particular formations and the average size of accumulation. In its simplest form, the estimate of the potential supply is derived by (1) estimating the volume of potential gas-bearing reservoir rock; (2) multiplying this volume by a yield factor and (3) discounting to allow for the probability that the traps and/or the accumulations exist."

Three separate categories for conventional natural gas are presented in the chart in Figure 12: (1) probable reserves; (2) possible reserves and (3) speculative reserves. Coal seam gas was studied separately and is presented as a separate (possible) category. The provinces are shown on the map in Figure 13.

Note on the chart that Montana has *3.285 TCF of "conventional"* gas in the probable category and *5.995 TCF* in the possible

FIGURE 12

Estimated Future Reserves of Natural Gas in Montana (in billions of cubic feet (BCF)

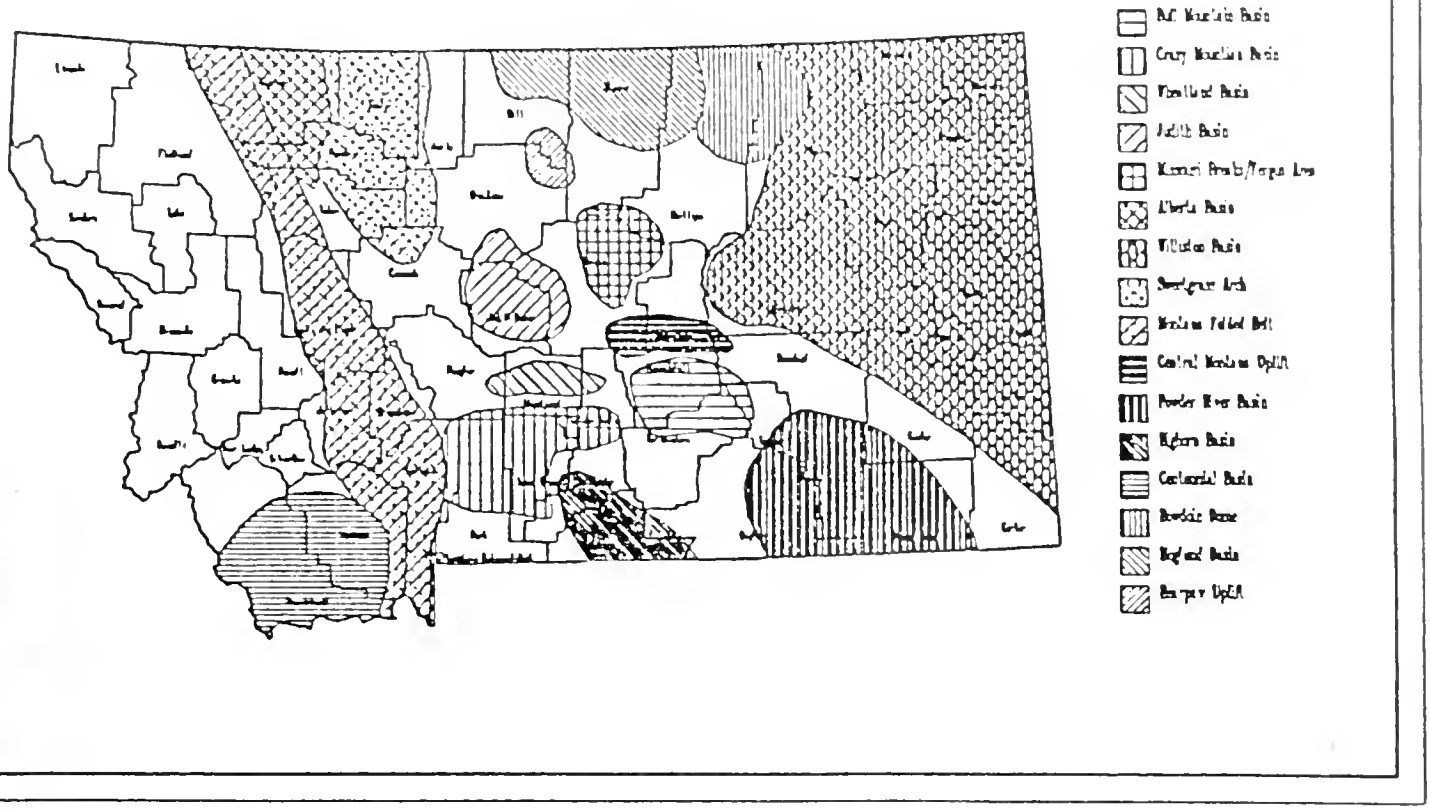
(Data from Potential Gas Agency, Colorado School of Mines (Harry C. Kent, Director), Balcron Oil Company files, and Gas Research Institute)

PROVINCE	PROBABLE CONVENTIONAL	POSSIBLE CONVENTIONAL	TOTAL PROBABLE/ POSSIBLE/ CONVENTIONAL	SPECULATIVE CONVENTIONAL	POSSIBLE COALBED GAS	GRAND TOTAL
I* Williston Basin	500	250	750	150	420	1,320
II Powder River Basin	375	735	1,110	167	9,111	10,388
III Big Horn Basin	110	110	220	---	1,340	1,560
IV* Sweet Grass Arch North Central MT, Central MT, Northern Thrust Belt	2,300	1,900	4,200	1,100	3,160	8,460
V* Southern Thrust Belt, Centennial Basin	---	3,000	3,000	3,000	2,000	8,000
TOTALS	3,285	5,995	9,280	4,417	16,031	29,728

* Province I includes: Bowdoin Dome and Williston Basin Fields

Province IV includes: Hoglund Basin, Bearpaw Uplift, Central Mt. Uplift, Missouri Breaks-Fergus, Judith Basin, Crazy Mountain Basin, Alberta Basin, Northern part of Mt. Folded Belt, Wheatland Basin

Province V includes: Southern part of Mt. Folded Belt



GEOLOGIC BASINS OF MONTANA

FIGURE 13

category. Coal seam gas is just beginning to be evaluated in the state, but with the nation's largest coal reserves, Montana undoubtedly has tremendous amounts of gas within the coal beds. Adding all categories gives a possibility of 29.728 TCF of future natural gas reserves.

PROVEN AND POTENTIAL NATURAL GAS PROVINCES

Montana has 16 separate provinces which have natural gas potential; half of these are presently producing. These 16 provinces are identified in **Figure 12.** Areas between the provinces should not be ruled out as potentially productive as they may hold significant reserves. **Figure 13** shows the location of presently producing fields.

WILLISTON BASIN

The earliest commercial gas in this basin was produced from shallow Cretaceous reservoirs developed across the huge Cedar Creek anticline, a northwest-southeast trending structure located in portions of Dawson, Wibaux and Fallon counties. More recently, development of Ordovician, Devonian and Mississippian oil reservoirs have led to significant production of associated gas.

The following formations presently produce natural gas in the Williston Basin:

Age	Formation
Cretaceous	Judith River
	Eagle
	Carlile (Bowdoin)
	Greenhorn (Phillips)
	Muddy
*Mississippian	Charles
	Mission Canyon
*Mississippian-Devonian	Bakken
*Devonian	Nisku
	Duperow
	Dawson Bay
	Winnipegosis
*Silurian	Interlake
*Ordovician	Stony Mountain
	Red River

*** associated gas**

Associated gas will continue to represent a large percentage of Williston Basin reserves as oil prospects are developed and drilled. However, considerable potential exists for development of

shallow, Cretaceous age reservoirs. Recent work by Larry Monson, exploration manager for the Fort Peck Tribe, and others have demonstrated considerable potential in northeast Montana in the following formations: Judith River, Eagle, Carlile (Bowdoin Zone), Greenhorn (Phillips Zone), and Muddy Formations, all of Cretaceous age.

POWDER RIVER BASIN

The Powder River Basin has not produced significant amounts of natural gas in its productive history; however, gas is presently being produced from shallow, Cretaceous sandstones where porous beds lap across structural noses in four small fields. These are: Liscom Creek, Pumpkin Creek, SE Bell Creek and Hammond fields.

Natural Gas producing formations in the Powder River Basin are as follows:

Age	Formation
Cretaceous	Eagle (Shannon Zone)
	Muddy

The Shannon zone of the Eagle is presently the major producing zone in the basin and many other opportunities for fields such as Liscom Creek and Pumpkin Creek exist. Over 30 structures similar to those of these two fields have been mapped in an area encompassing about one-third of the Montana portion of the basin. If the Shannon is developed over these structures, or over other unmapped structural noses in the Basin, several fields as large as Pumpkin Creek and Liscom Creek (or larger) no doubt exist.

Additional gas is also likely in the Muddy Formation, and the Judith River should also be prospective over a large part of the area.

Deeper Paleozoic exploration programs have been disappointing for either oil or gas, but not enough data exists to completely eliminate the Paleozoic formations from consideration.

The greatest potential probably lies in development of coalbed methane reserves. Coal reserves are enormous, and many experts assign several TCF of methane to these beds. These beds are in the Fort Union Formation (lower tertiary age) and are relatively close to the surface.

BOWDOIN DOME

Bowdoin Dome is a very large domal structure covering significant portions of Valley and Phillips counties. Recently,

this area has been the center of Montana drilling activity as several hundred development wells have been added to the system over the last two years.

The Carlile (Bowdoin Zone) and Greenhorn (Phillips Zone) produce on the Bowdoin Structure. These are both Cretaceous in age and consist of thin sandstones interbedded with organic rich shales. The wells generally require hydraulic fracture stimulation, but after going on production, economic well life is generally 30 to 40 years, or more.

Other, largely untested formations that have potential are: (1) Muddy (Cretaceous) and (2) Tampico member of the Piper (Jurassic).

CENTRAL MONTANA UPLIFT

The Central Montana Uplift has produced no commercial gas to date but small amounts of associated gas have been produced and used to operate lease equipment. This province, however, has future potential inasmuch as thick, porous sand bars in both the Eagle and Judith River Formations (Cretaceous) are known to trend through the area. The Eagle and Judith River are major gas producers in the Tiger Ridge area to the north of the Central Montana Uplift and rock characteristics in central Montana are believed to be identical to the producing rocks of Tiger Ridge.

Other zones that could contain gas reserves are the Muddy, Dakota (1st Cat Creek) and Lakota (3rd Cat Creek) of Cretaceous age, and the Amsden and Tyler Formations of Pennsylvanian age. Deeper Paleozoic rocks could be prospective, but little is known about them in this area.

BULL MOUNTAIN BASIN

The Bull Mountain Basin is mostly in southern Musselshell and northern Yellowstone counties. To date this basin has not produced commercial gas. However, considerable potential exists in several formations. Because of significant coal deposits in the Fort Union Formation (Tertiary age) the province qualifies as a potential coalbed methane producer and as in the Powder River Basin, the reserves could be significant. In addition the Judith River, Eagle, Mowry, Muddy, Dakota and Lakota rocks (Cretaceous age) are all potential commercial gas producers. The Mowry deserves special mention in that it is a fractured shale and siltstone source bed much like the Bakken in the Williston Basin and the Niobrara of Colorado and Wyoming. This unit is a notorious lost circulation zone, and consequently, little is known about its fluid content or productive capability, but because of its source bed quality, the unit needs evaluation.

The Pennsylvanian Amsden could hold commercial gas in some parts of the basin as gas shows have been noted in several drill stem tests of the unit and gas associated with oil production is common with the Amsden at Pole Creek, Gage, and Wolf Springs Fields where the unit produces. As for Deeper Paleozoic rocks, an evaluation must await the drilling of additional control wells.

BIG HORN BASIN

The first commercial well in Montana was drilled in 1915 in the Elk Basin Field near the Wyoming border. Since that time gas has been produced with the oil production from the Frontier, Tensleep and Madison reservoirs in both Elk Basin and Northwest Elk Basin fields. In addition, the Dry Creek and Clark's Fork Fields both produce natural gas and Dry Creek also serves as a gas storage facility for Montana Power.

The following formations produce natural gas in the Big Horn Basin:

Age	Formation
Cretaceous	Judith River
	Eagle
	Frontier
	Greybull
*Pennsylvanian	Tensleep
*Mississippian	Madison

*associated gas production

The northern part of the basin has considerable potential for natural gas in Cretaceous sandstone reservoirs from both structural and stratigraphic traps. In addition extensive coal deposits in both Lower Tertiary and Cretaceous formations have considerable coalbed methane potential.

The western flank of the basin has been overthrusted and is generally believed to have great oil and gas potential beneath the thrust sheets. Records from an earlier chrome mining operation near Nye indicates the presence of methane gas in fractured Precambrian crystalline rocks. This gas undoubtedly originated in younger rocks (probably Cretaceous) beneath the thrust.

Adding to the attractiveness of natural gas exploration in the Big Horn Basin is the availability of markets through two pipelines: (1) Montana Power Company and (2) Williston Basin Interstate Pipeline Company. Both companies have pipelines traversing the basin and both have nearby interconnections which would allow movement of gas to end users elsewhere.

CRAZY MOUNTAIN BASIN

The Crazy Mountain Basin has several small gas fields presently producing (Big Coulee, Lake Basin, Rapelje, North Lake Basin, Six Shooter and several isolated wells producing from small fault blocks in the Lake Basin Fault zone).

The following formations produce natural gas in the Crazy Mountain Basin:

Age	Formation
Cretaceous	Judith River
	Claggett
Cretaceous	Eagle
	Frontier
	Big Elk
	Lakota
Jurassic	Morrison

The Crazy Mountain Basin could become a major natural gas province. The basin contains one of the thickest sections of Cretaceous rocks in the northern Rockies. (The Cretaceous System is responsible for the majority of gas produced in the Rocky Mountains.) In addition, the Paleozoic section should have high potential, particularly on structural traps. Source bed conditions should be ideal for gas generation in the central part of the area, and coal beds could be sources of methane throughout.

WHEATLAND BASIN

The Wheatland Basin is almost totally unexplored except for tests along the Shawmut - Woman's Pocket Anticlinal Trend which marks the southern flank of the basin. Well records from this drilling activity indicate gas shows in several zones, and one small shut-in field exists near the town of Shawmut. This field has one well completed in the Pennsylvanian Amsden Formation and one well in the Cretaceous Thermopolis Sandstone. The Amsden gas has a small amount of sulfur which will require treating before the gas will be useable.

Out in the basin proper Cretaceous beds are the most likely producers. Under proper conditions the Judith River, Claggett, Eagle and especially the Frontier Section (Big Elk and others) should have potential.

JUDITH BASIN

The Judith Basin's gas potential is mostly unevaluated. The northern part should have shallow gas potential in Cretaceous

sandstone reservoirs. However, there are no markets for gas in the area, and water flow problems could exist in some zones.

MISSOURI BREAKS - FERGUS AREA

This province has had a few test wells drilled over the years, several of which had gas shows in Cretaceous rocks (Eagle and Judith River), and at least one well is shut-in waiting for a market. Gas development in this area will be slowed due to lack of pipelines and some of the prospective area is along the Missouri River which carries a "Wild and Scenic River" designation in this area.

The Altamont pipeline would cross this province and if built, provide a possible gas market and create some exploration activity.

HOGLUND BASIN - BEARPAW UPLIFT

The Hoglund Basin is bordered on the south by the Bearpaw uplift and these two areas provide Montana's greatest volume of natural gas production. The area includes the Tiger Ridge Field, presently Montana's largest natural gas producer, and several other significant fields.

The following formations produce gas in the area:

Age	Formation
Cretaceous	Judith River
	Eagle
Jurassic	Sawtooth

Most of the gas in the province is produced from fault blocks that form traps in the Eagle and Judith River sands. Most of the obvious faults have been drilled, but seismic surveys are detecting faults not visible with other exploration techniques. In addition, anticlinal folds and stratigraphic traps probably exist. Many parts of the area have yet to be drilled. Most likely producers are the Judith River, Eagle and Sawtooth Formations, but exploration in the deeper Paleozoics could yield production from the Mississippian and Devonian rocks.

SWEETGRASS ARCH

The Sweetgrass Arch is a major gas producing province in Montana with the huge Cut Bank Gas Field the top field. The area has the greatest number and age diversity of reservoirs in Montana

with production from Devonian, Mississippian, Jurassic and Cretaceous ages.

The following formations produce gas on the Sweetgrass Arch:

Age	Formation
Cretaceous	Fish Scale Member of Black Leaf Formation
	Bootlegger Member of Black Leaf Formation
	Bow Island
	Dakota
	Sunburst
	Cut Bank
Jurassic	Swift
	Sawtooth
Mississippian	Sun River-Mission Canyon (Madison)
Devonian	Nisku

Associated gas is also produced with oil from the Nisku, Madison, and Sunburst rocks.

The Bow Island Sands are widespread in the area and produce from both stratigraphic and structural traps. Although low in reservoir pressure, these sands produce significant gas and many areas where the sands are known to exist have not been tested. Although sour (sulfur bearing), rocks of the Madison group should have significant gas reserves. Remaining large reserve fields will probably be found mostly in these rocks.

ALBERTA BASIN

This province probably has some of the greatest natural gas potential left in the state. It lies between the Sweetgrass Arch and the overthrust and extends into Canada where significant production has already been found. All the zones listed above as productive on the Sweetgrass Arch are prospective in this area.

The province is underexplored. Most of the land is Blackfeet Tribal land and various tribal policies have limited exploration in the past. Some of the southwestern part is in the Lewis and Clark National Forest.

MONTANA THRUST BELT

The Montana Thrust Belt is recognized by several experts as having some of the greatest potential left to be drilled in the lower 48 states. A short distance north of the border, in this same structural province, the Waterton Field is located. Waterton

contained a reserve base that included 2.75 TCF of natural gas and 125 million barrels of oil. Trapping mechanisms similar to those that produced the Waterton Field are known to exist in several areas in the Montana portion of the trend and the probability of large reserves is high.

To date the only production in the Montana portion of this province is at Blackleaf Canyon where rocks of the Mississippian Madison group produce gas. If conditions like those at Waterton do exist, both the Devonian and Mississippian rocks should produce over the prospects.

Development of prospects will be difficult in the existing regulatory climate. Most of the land in the province is federally owned, primarily in National Forests. In addition, proposed wilderness legislation, if passed, will remove several hundred thousand acres of prospective lands from any consideration.

CENTENNIAL BASIN

The Centennial Basin is another unexplored Montana province. Geologic studies by several companies have revealed conditions suggestive of hydrocarbon potential. Very little exploration has been accomplished, however, due to abundance of Forest Lands which presents numerous access problems.

OBSTACLES TO DEVELOPMENT OF MONTANA NATURAL GAS

Numerous in-depth studies conclude that Montana has a high probability of major undeveloped Natural gas reserves. One of the objectives of this report is to identify the obstacles to development of these reserves. The following is a discussion of the obstacles as identified by the Governor's Council.

FIRST, Montana has a small population with few large industrial users of natural gas. As a result, in-state markets are minimal and producers must look to out-of-state markets when new, large reserves are found. Because Montana is located at considerable distances from major population centers, transportation costs are significant and reduce the net profit to the producer.

SECOND, Montana has few pipelines for transportation of gas. Figure 1 shows pipeline routes in the state. The existing lines have limited excess capacity and would need upgrading to handle any large new supply. The proposed Altamont Pipeline, extending north-south through the center of the state, offers opportunities to move gas to out-of-state users, but this line is still waiting final approval. In addition, many of the areas, where high potential for large gas reserves exist, are located 100 miles or more from entry points into any of the existing or proposed pipeline systems.

THIRD, access to many of Montana's large reserve prospects is limited because they lie beneath federal surface. This is a particular problem with national forest lands. Wilderness study and Forest Service review of environmental impacts prior to leasing have halted any kind of activity on many of these lands for six years or more. Many major and large independent exploration companies have stated that if access problems were solve, they would designate significant portions of their exploration budgets, almost all of which is now being spent overseas or in the Gulf Coast area, to these high potential prospects.

FOURTH, Montana natural gas taxes are the highest in the nation which places producers at a competitive disadvantage when attempting to attract new investment into exploring for new gas reserves in the state. Figure 15 compares Montana taxes with those of other Rocky Mountain gas producing states.

FIFTH, Montana producers must compete with Canadian and other out-of-state gas for existing markets within the state. Presently, due in part to Canadian government subsidies, significantly lower taxes in neighboring states, and an abundance of already developed gas supplies in Canada, this gas is coming into Montana at a considerably lower price than the prevailing prices within the state.

FINALLY, Montana does have a negative image as a place to do business, particularly within the oil and gas business. Several points discussed above contribute to this but others add significantly to it as well. For example, workers' compensation rates are extremely high compared to other states, and this is especially true within natural resource industries such as oil and gas. Also, although the aggressive audit policies of the Department of Revenue have been tempered somewhat, practices of the past are still remembered and Montana producers have a difficult time finding companies who are willing to work in Montana again due to unpleasant experiences from earlier years.

RECOMMENDATIONS
GOVERNMENTAL AFFAIRS

The oil and gas industry contributes a significant portion of Montana's tax revenue each year and provides a number of high paying jobs to citizens of this state. The industry has suffered in recent years due to collapse of both oil and gas prices and intense pricing competition created by continent-wide supply/demand imbalances. When industry revenues suffer, so do state and local government revenues. Government and industry can form a **"partnership"** in order to develop and market Montana's vast natural gas supplies.

Several steps could be taken which could encourage exploration, development and marketing of Montana gas. The following is a discussion of steps which the Council recommends.

State government should join industry in promoting Montana's **"business image"**. State business promotion efforts can emphasize the positive aspects of natural gas exploration and development in the state and allay fears of unreasonable treatment at the hands of government agencies. Both the Governor and Lt. Governor have recently visited with groups along these lines, and these efforts should be intensified.

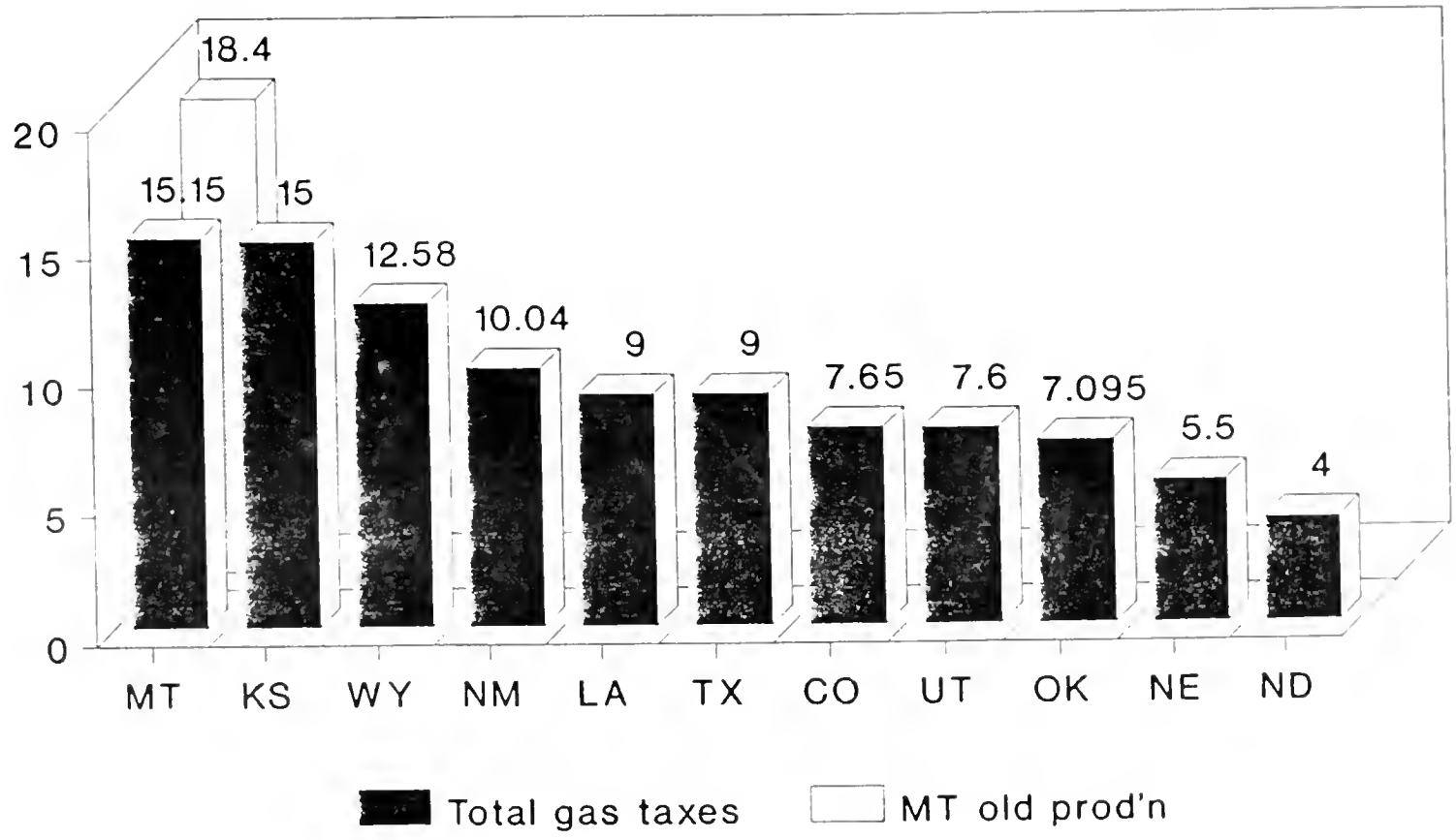
State government should promote simplification and consistency in taxation. Oil and gas production presently has **four** different taxes levied upon it, over and above property and income taxes! This contrasts with one or two wellhead taxes in most producing states. In addition, total production tax on "new" natural gas should be lowered to that of "new" oil (gas is taxed at 15.35% whereas oil has 12.7% total production taxes). Little justification exists for this difference when it costs just as much to explore for natural gas as it does for oil. Also, a two year tax holiday on severance and proceed taxes should be enacted in order to make the state more competitive and to spur new drilling activity.

The Resource Indemnity Trust Tax (RIT) was enacted to provide a fund for reclamation from the development of nonrenewable resources. Although the petroleum industry has an excellent record of reclaiming its projects, RIT money has rarely been appropriated for oil and gas clean up. More RIT funds should be used for clean up of "orphan" wells (those for which no responsible operator can be found, or that were drilled prior to the bonding law). All RIT taxes paid by the petroleum industry should be channeled directly into oil field cleanup.

The dual taxation -- by both the state and individual tribes -- on Native American lands creates an unattractive economic

Natural Gas Taxes

Approximate Composite Rates



Compiled by RMOGA

Because of variations in taxation methodology, composite rates are approximate. For example, North Dakota's tax is actually 4¢/MCF and therefore actually less than 4%. Louisiana's is 9¢/MCF.

situation. A compromise between the state and tribes should be reached. In addition, the tribes should develop a list of tribal lands that are off limits to petroleum development. This would prevent a waste of industry time on prospects that cannot be developed due to tribal objections.

The state should limit revenue audits to picking one tax year within a five year period with a five year statute of limitations. With the tax change from the net proceeds to the gross proceeds on production, the net proceeds audits, which caused so much anguish in the past, are diminishing, and will eventually disappear, but other audits will continue and the five year limitation is preferable.

The workers' compensation dilemma must be solved. The Council recommends that the program be completely privatized and that the existing policy requirements be re-evaluated.

State government should be more active in lobbying the federal government on multiple use issues. Most of Montana's large reserve potential lies on federal land, particularly in national forests, and access to these prospects is critical. The governor's office should work with the Montana Petroleum Association and the Northern Montana Oil and Gas Association to change the Forest Service policies on leasing that have essentially shut down natural gas exploration in Western Montana. The environmental evaluation prior to leasing is proceeding so slowly, that if continued at this pace, Montana's huge potential may not be evaluated until well into the next century. In addition, the wilderness bill presently before Congress removes at least 500,000 acres of land considered by industry to be highly prospective for natural gas. The governor's office should also be involved in lobbying the state's congressional delegation for changes in wilderness boundaries so that non-potential lands are substituted for those that are prospective.

Oil and gas can be and are being developed today in a prudent and environmentally sound manner. The state administration should work to alleviate unreasonable challenges to oil and gas operations, when these operations pose no threat to the environment. Government and industry have many common goals, but to reach these goals, relationships must be established which infuses trust into them. The Council recommends an on-going government/industry committee to address this problem.

Other recommended governmental actions to encourage natural gas development and use in Montana are as follows:

1. Provide an incentive to access and use State lands by: (a) implementing a 24 month State royalty holiday on new production; (b) increasing availability of State lands

for new natural gas markets; (c) developing incentives for new pipeline construction.

2. Existing state economic development committees should:

a -Develop expertise (through use of an established industry consulting group) in natural gas matters and promote the value-added concept to meet Montana's energy needs with Montana gas before it is marketed outside the State.

b -Promote Montana's natural gas at industry market events.

c -Inaugurate and maintain an education campaign to raise potential markets', government's and general public's awareness of natural gas as the "fuel of choice".

3. Promote pipeline development by revision of rate-making policies of the public service commission.

MARKETING STRATEGIES/RECOMMENDATIONS:

Market share and growth will be the key to establishing respectable gas prices and development promotion. These are recommendations to industry: producers must bring market understanding to the forefront of their operations. This entails:

1. Knowing the existing markets/end uses both in state and out.

2. Knowing what potential markets may exist and working toward their development. In Montana examples of new market potential are:

A. **Power generation**
   1. Electric generation
   2. Co-generation
   3. Co-firing applications with other fuels

B. **Transportation**
   1. Railroad, through use of refrigerated liquid methane (RLM,) to fuel locomotives.
   2. Use of compressed natural gas (CNG) in vehicles.

C. **Agri-Business**
   1. Malting barley
   2. fertilizer plants
   3. grain drying

D. **Cement and hot mix plants**

E. **Enhanced oil recovery projects**

F. **Wood product plants**

G. **Talc processing plants**

H. **Smelters**

3. Know the competition for the markets and the competitive factors.

4. Know who the industry is: producers, aggregators, pipelines, markets, regulators.

5. Understand and take a role in pipeline services, i.e., rates, quality of service, storage potential, operating characteristics. Work with pipelines to ensure that regulatory barriers do not exist which would impair timely capacity expansion opportunities.

6. Explore the potential of producer gas sales to co-ops, producer pools or utilization of aggregators in sale of gas.

7. Understand pipeline gathering facilities and be prepared to engage in that activity.

8. Work with State, Federal and Tribal governments to educate officials and achieve regulation parity with competing gas supplies (continental) and alternate competitive fuels (coal, propane, fuel oil etc.)

9. Promote natural gas as the "fuel of choice" to Federal/State officials and general public.

10. Establish a natural gas resource marketing contact in state government. Promote Montana natural gas at industry trade shows, such as Gas Mart.

11. Explore integrating natural gas into state and regional Integrated Resource Planning (IRP) and Least Cost Planning (LCP).

FEDERAL EFFORTS

Nationally, awareness is growing of the importance of a secure natural gas industry. Montana producers and government should work to see that Montana gas is part of this picture.

From the Oil & Gas Journal, March 23, 1992:

A new study argues the U. S. should redouble its spending on natural gas research, development, and demonstration projects.

The Washington Policy and Analysis study said: "If the current federal effort were more than doubled, clear and direct returns to the economy would begin to recover the costs within only 3 years."

More research, development, and demonstration (RD&D) would help the U. S. shift to even greater use of plentiful gas supplies.

"The likely returns in U.S. jobs, increased output, energy efficiency, and enhanced American industrial competitiveness are enough to start exceeding the cumulative costs of a well conceived RD&D program within as little as 3 years.

"The year-by-year payoff in the longer run, even with conservative assumptions, rises steadily to about 10 times the corresponding cost -- as early as 2000. And this does not even count the value of 'externalities' such as a cleaner environment, much less a variety of benefits to energy consumers and the singular added economic advantages of improving U.S. competitiveness in world trade and making overall energy prices more stable in the future."

The paper said the gas industry and equipment manufacturers will spend more than $400 million on RD&D this year...The increased government revenues that can be projected from the greater use of domestic natural gas traceable to adequate RD&D, which we calculate at about 2.7 quads/year by 2010, are more than enough to cover the cumulative investments by themselves."

The paper added that enhancing the end use of natural gas is not the whole picture.

"Americans who believe it is desirable to use this relatively clean energy source more widely -- a group of people that appears to include most members of Congress and all major presidential candidates -- need to agree on where and when gas exploration, development, and production may take place."

Meanwhile, the U.S. Department of Energy is working on a natural gas strategy designed to improve prospects for the fuel "from borehole to burnertip."

Quoted in the Oil & Gas Journal of April 20, 1992, Energy Secretary James Watkins said, *"The strategy emphasizes programs to improve utilization, delivery, and storage of natural gas, and it refocuses ongoing supply related R&D to better reflect near and midterm needs.*

"Rather than several separate -- and often disparate -- natural gas related activities proceeding in DOE with little coordination, we are now proposing a single cohesive approach. Also, we have identified several areas where federal R&D investment

has been lacking, and we are proposing new initiatives to fill these gaps."

In production, DOE plans to continue developing a gas atlas and database for the entire U.S.

It will seek technologies to upgrade low quality gas, develop air horizontal drilling technology for low permeability formations, and develop technologies for secondary gas recovery.

These activities present opportunities for Montana. By achieving the recommendations in this report the industry and state government can position Montana natural gas to be part of this exciting picture.